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EFFECTS OF PRECOOLING, SALTING, CARTON VENTILATION, AND LOAD PATTERN ON TEMPERATURE, MOISTURE CONDENSATION AND SPOILAGE IN RAIL SHIPMENTS OF PREPACKAGED EARLY BLACK MASSACHUSETTS-GROWN CRANBERRIES

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INTRODUCTION

Approximately 50 percent of the estimated 10,075,400 barrels of cranberries grown in the United States in 1953 were marketed fresh. Most of these berries were packed in 1-pound cellophane bags. Some were packed in 1-pound boxes, and a few were measured out to the consumer from the old 1/4-barrel wooden boxes.

Persons in the cranberry industry, the Association of American Railroads, and the New York, New Haven, and Hartford Railroad were anxious to improve the arrival condition of Massachusetts-grown Early Black cranberries at distant markets, such as Los Angeles, Chicago, and Detroit. One of their prime concerns was to eliminate moisture condensation on the outer and inner surfaces of the cellophane bags and the master cartons in which the bags are shipped. The other objective was to get the berries to the consumer with a minimum of spoilage.

Decay is directly related to temperature and moisture condensation. Therefore, tests were initiated in 1953 to compare present loading and cooling practices with certain modifications of these two factors, with special reference to the effect of carton ventilation, load pattern (carton spacing), and car fan precooling on temperature, moisture condensation, and spoilage. Additional tests were conducted in 1954 on the effect of precooling when salt was used with the ice in the bunkers.

METHODS

Little trouble with condensation has been noted in window boxes or in 1/4-barrel wooden boxes. However, the cellophane bag, the most popular consumer package for cranberries, has been subject to considerable moisture condensation. Therefore, Early Black cranberries in 300-gage LSAT cellophane bags, packed in master fiberboard cartons, were used in these tests. 1/

In 1953 2 preiced cars were loaded on each of 4 days. One car of each pair went to Los Angeles, and the other went to Chicago in three of the tests and to Detroit in the fourth. In compliance with minimum load regulations, the Los Angeles cars were loaded with 1,133 cartons containing twenty-four 1-pound packages. The Chicago and Detroit cars were loaded with 962 of these cartons. The inside dimensions of the cars were 33 feet 2 3/4 inches by 8 feet 3 inches by 7 feet 3 inches, except for cars 5 and 7, which were 38 feet 3 inches by 8 feet 8 inches by 7 feet 8 1/2 inches. The berries for each pair of cars were harvested on one day, sorted the next day, packed the third, loaded the fourth, and dispatched the fifth.

1/ In the Los Angeles test cars, one end of each car was loaded with cartons containing window boxes and 1/4-barrel wooden boxes of bulk fruit, but it was felt that these had practically no effect on the temperature changes and spoilage of the bagged berries in cartons under test in the other end of the car.

Thus, each pair of cars left Wareham Mass., 4 days after the fruit was harvested, following approximately the average time schedule in commercial practice. Comparisons were made of precooling vs. not precooling, short-flap cartons (ventilated) vs. standard cartons, and a solid load vs. a channel load.

Precooling after loading was accomplished by using 1 1/2 horsepower gasoline motors to drive the standard, floor-type fans, which circulated the air through the ice bunkers and loading space. In each pair, the precooled car was destined for the more distant market (Los Angeles). The fans were operated for 8 hours in cars 1 and 3 and for 24 hours in cars 5 and 7. The midwestern cars were not precooled.

The standard-size cranberry carton (8 1/2" x 15" x 16 1/2" in outside dimensions) was used, with fiberboard separators dividing the carton into 4 compartments, each containing 3 layers of 2 bags each. In the standard carton the outer flaps met or nearly met, with little or no space between them. The short-flap cartons had flaps 2 inches shorter than the standard carton flaps, providing an opening 4 inches by 5 1/2 inches at the top and bottom of each carton when the flaps were closed.

All cars were loaded 6 cartons wide and 7 cartons high in the test end. The solid load was obtained by placing the cartons with the long side lengthwise of one car in 2 rows next to the wall and with the remaining 4 rows crosswise (Fig. 1). The channel load was obtained by placing the cartons with the long side lengthwise in the car, leaving about 2 inches of space between each of the 6 rows of cartons and its adjacent rows of cartons for the entire length of the car. In the larger Los Angeles cars (Cars 5 and 7) the wall rows in the channel loads were about 2 inches from the side walls, whereas in the smaller cars the rows were flush against the walls.

To maintain the channels in the load during transit, glue was applied in two 3/4-inch bands on the bottom of each carton. In addition strips of fiberboard (3" x 5/16") were placed crosswise in the car above the second, fourth, and sixth layers in each stack. All cars were equipped with floor fans and wall flues (wall racks in car 7).

All cars were preiced before loading and shipped under standard refrigeration, fans on, vents closed, plugs in, to destination. The bunkers were replenished when necessary before the cars left Wareham, Mass.

Temperature data were obtained during precooling at Wareham with thermocouples placed in nine cartons in the top, middle, and bottom positions in the center-line bunker, quarter-length, and doorway stacks. They were also placed at the bottom- and top-bunker openings to give the temperatures of the air entering and leaving the ice bunker. The thermocouple leads were run outside the car to allow reading without opening the car doors and affecting conditions within it. Temperature data from time of packaging to time of unloading were recorded by using Ryan recording thermometers placed in the same top- middle- and bottom-quarter-length test cartons. Outside air temperatures during precooling and transit were recorded with a Ryan thermometer placed outside, underneath the car. Inside air temperatures were obtained with a Ryan thermometer attached to the ceiling of the car near the top of the bunker opening.

Samples were obtained at time of packaging for immediate inspection upon arrival at destination, and for inspection after 3 and 7 days at 70° F. and 80 percent relative humidity at destination. Three 1-pound sample packages from each car were inspected at time of packaging, 9 sample packages placed in cartons in each of the top, middle- and bottom-quarter-length positions in each car, 3 to be used for each of the 3 destination inspections.

At each of the inspections a 100-berry sample was taken at random from each of the 3 packages and cut to determine internal decay and physiological breakdown. The remaining berries, which averaged approximately 425 per bag, were counted and examined without cutting to determine externally the visible decay. The inspection of the uncut sample would be comparable to a commercial inspection.

Notes were made at destination on the condition of the load with special emphasis on shifting, damage to cartons and packages, and moisture condensation.

In the 1954 tests, 1 pair of cars (cars 9 and 10) were shipped from Plymouth, Mass., to Los Angeles and 1 pair of cars (cars 11 and 12) to Chicago. In these tests 450-gage LSAT cellophane bags of Early Black cranberries were packed in standard master 4-compartment fiberboard cartons.

During loading, each carton was spot glued on top at two opposite corners. Corrugated stripes were also spot glued and laid crosswise of the car over the second, fourth and sixth layers, with the sixth layer glued only in stacks over 6 cartons high. Doorway cartons were not stripped. The cars were loaded with the cartons crosswise, 5 wide and 8 high in cars 9 and 10 and 5 wide and 7 high in cars 11 and 12 (Fig. 2). This type of load provided 2 1/2 to 5 3/4-inch channels between rows, except at the wall, for air circulation through the entire length of the cars. The Los Angeles cars contained 520 cartons of twenty-four 1-pound packages of cranberries in cellophane bags and 210 cartons of twenty-four 1-pound packages of cranberries in window boxes. The Chicago cars contained 660 cartons of cellophane bags and 210 cartons of window boxes. The test end of each car contained only the cellophane bags.

The cars were preiced, and 5-percent salt was added to the bunkers. Each car also received 200 pounds of salt during the precooling period.

Precooling one of each pair of cars was done by attaching electric motors to the built-in floor fans. The fans operated 19 hours in car 9 and 18.5 hours in car 11. The bunkers were replenished with ice and salt before the cars left Plymouth. They were then forwarded to destination, with fans on and plugs in under standard refrigeration, plus about 3-percent salt at all but 2 re-icing stations. It was intended to add salt only at the first 2 re-icing stations, but because of misinterpretation salt was added at all but 2 re-icing stations.

Temperature data were obtained during precooling with thermocouples and Ryan recording thermometers as in the 1953 tests and placed in the same positions.

Field heat was removed from some lots of cranberries by hydrocooling in ice water prior to packaging. The test fruit in the Los Angeles cars was harvested 4 days before loading. The fruit in the Chicago cars was held 3 to 7 days in the warehouse before sorting and was shipped 3 days later.

Sampling and inspection methods at origin and destination were the same as those described for the 1953 tests. In the 1954 tests an additional carton was placed at the bottom layer at the bunker to determine whether freezing occurred when salt was added.

RESULTS

Temperatures

In 1953 the fruit temperature, as recorded by Ryan thermometers, from time of packaging to time of loading (table 1) ranged from 62° to 70° F. for all cars except 3 and 4, in which the temperature ranged from 70° to 79°. The thermocouple records (table 2) show that precooling 8 hours lowered the commodity temperature in all positions in the precooled loads (car 1, 3, 5, and 7) an average of 7.5°, 8.1°, 7.1°, and 6.2°, respectively. Precooling for 24 hours lowered the average commodity temperature 18.0 and 16.9° in the channel loads (cars 5 and 7) but only 9.9 and 11.3° in the solid loads (cars 1 and 3). As expected from the direction of the air flow during precooling, greatest temperature change was in fruit in top-layer cartons.

In preiced but nonprecooled loads (cars 2, 4, 6 and 8) the temperature of fruit during these same time periods rose slightly in some positions. However, the average temperatures were reduced 0.7°, 2.6°, 0.8°, and 1.0° F. after 8 hours and 2.9°, 5.5°, 6.1° and 5.9° after 24 hours, respectively. In contrast to precooled cars, lowest temperatures in non-precooled cars were found in the bottom layer.

Comparison of the average fruit temperatures in channel loads 24 hours after loading shows that the temperatures dropped only about a third as much in nonprecooled cars as in precooled cars. The lower temperature in precooled cars was maintained during practically all the transit period in most positions in all 4 pairs of cars (table 1). The considerably higher temperatures at the last two readings for car 8, the Detroit car, occurred after unloading, while the test packages were being shipped to Chicago for inspection.

Figure 3 shows graphically the difference in average temperature and rate of temperature reduction between precooled and nonprecooled cars, short-flap cartons, and standard cartons and solid loads and channel loads. The greatest difference in temperature reduction occurred between the precooled and nonprecooled loads, averaging 8° to 11° F. after 8 to 24 hours' precooling. The car fans were effective in lowering the fruit temperature during transit in both the precooled and the nonprecooled cars, and the advantage of lower temperature gained by precooling was maintained during the transit period (figure 3A).

Lower fruit temperatures were recorded in the channel load than in the solid load. When comparing the 2 types of load, it should be noted that the solid loads were precooled for 8 hours while the channel loads were precooled for 24 hours (figure 3B). The fruit temperature was only about 1° lower in the short-flap cartons than in the standard cartons, during the 6 days after loading (figure 3C).

The highest average commodity temperature was found in the nonprecooled car loaded solid with berries in standard cartons (car 4), and the lowest in the precooled car channel loaded with berries in short-flap cartons (car 5), (figure 3D). The commodity temperature was reduced an average of 15° F. more in car 5 than in car 4 during the 6-day period following loading.

Outside air temperatures were approximately the same for the 8 cars during the 6-day period.

The fruit temperature during packaging in 1954 averaged 76° F. for cars 9 and 10; and 71° for cars 11 and 12. These temperatures dropped only slightly before loading. The data in table 3 and figure 4 show that cooling (with salt added to the bunkers) was more rapid in the precooled than in the nonprecooled cars. Precooling 18.5 and 19 hours resulted in a drop of 21.3° and 19.8° in cars 9 and 11. In the nonprecooled cars (cars 10 and 12), on the other hand, the temperature was reduced only 9.2° and 7.7° by the time of departure. Thus the greatest difference in temperatures between the precooled and nonprecooled cars was 12.1° at the end of the precooling period. Since a shorter time for precooling may be available, it is interesting to note that the data shows that cars 9 and 11 were cooled 13° and 12.6° in 7 and 7.5 hours, respectively.

After the cars began to move and the fans to operate, the rate of cooling continued slowly in the precooled cars and at a rapid rate for about 2 days in the nonprecooled cars (table 4 and figure 4). After 3 days in transit average difference between the precooled and the nonprecooled cars was only 2° to 3° F.

No freezing was reported in any of the lots, although top air temperatures in car 10 reached a minimum of 28° F. (1° above the average freezing point of cranberries) after 3 days in transit.

Ice Meltage

Generally the greatest difference in ice meltage was found between the precooled and the nonprecooled loads, especially during the first part of the transit period (tables 5 and 6). No consistent difference was noted in this respect between loads of short-flap cartons and standard cartons or between solid and channel loads.

Condition of Loads

In general, the loads in the 1953 tests arrived at their destination with a minimum of serious damage to the cartons and the consumer packages. No master packages were rejected because of breakage. Cars 2, 4, and 6 to Chicago and car 8 to Detroit arrived with the loads in good order except in car 2 where some of the stacks leaned slightly toward one bunker wall. Cars 1, 3, 5, and 7 to Los Angeles arrived with more load shifting and more defects, especially in the channel and the short-flap carton loads. Some tilting or sawtoothing of stacks and creasing of packages were noted in all Los Angeles cars. Some of the shifting was probably due to longitudinal slack in the load.

Tearing of the cellophane bags resulted from snagging of the bags that bulged through the large opening at the bottom of the short-flap cartons. This precludes their use, since most fresh cranberries are sold in cellophane bags. In the channel-load cars to Los Angeles, the methods used to hold the row alignment failed and the channel was destroyed. Failure probably occurred near the California end of the trip, or there would have been more damage to packages. Although some cartons were crushed, all were in good enough condition to be accepted by the trade.

In the 1954 tests, cars 9 and 10, shipped to Los Angeles, arrived without noticeable damage and with very little creasing of the cartons even though considerable shifting, which was worse near the top of the load, was noted in both cars. No recoopering was necessary and no bad orders were recorded.

The Chicago cars (cars 11 and 12) arrived in better condition than the Los Angeles cars although some shifting of cartons out of position, especially in the top layers, was noted.

The 1954 spaced loads appeared to arrive generally with less crosswise shifting than the 1953 ones. This was probably due to the lengthwise corrugations in the strips, whereas in the 1953 tests the corrugations ran crosswise and did not provide as much rigidity. Gluing the top layer cartons to a strip with adhesive on top and bottom plus stripping the doorway stacks would probably help to keep the channels in better condition.

Moisture Condensation

Very little moisture condensation was noted on the cellophane bags or fiberboard cartons in the 1953 tests. In only one test was considerable fogging of the film bags reported. No packages were rejected because of this condition. In car 5 some bottom cartons were reported as wet as a result of blockage of the car drains. After drying, these packages were acceptable to the trade.

Moisture condensation was not noticeable on any 1954 test packages except the hydrocooled lots that were packaged wet.

Hydrocooling

Attempts were made to reduce quickly by hydrocooling the temperature of the cranberries prior to packaging. Cranberries with temperatures of 71° F., (lot 1) and 65° (lot 2) were cooled to an average of 39° and 34°, respectively, in about 15 to 20 minutes in ice water at about 33°. Lot 1 was then dried with toweling and packaged. During this procedure its temperature rose to about 60°. It was then shipped to Los Angeles in car 10. Lot 2 was packaged wet, and its temperature during packaging rose to only 40°. It was shipped to Chicago in car 12.

On arrival, lot 1 was dry and showed 1.5 percent decay, which increased to 6.2 and 12.2 percent after 3 and 7 days, respectively, at room temperature (70°).

On arrival the bags of the second lot were fogged and the berries were still wet. Decay rose from 4.8 percent on arrival to 10.1 and 37.5 percent after 3 and 7 days, respectively, at room temperature. The decay was softer and more advanced than in the nonhydrocooled lots.

Thus, heavy moisture condensation and wetness and decay of berries apparently preclude hydrocooling as a method of lowering the temperature of cranberries unless they can be adequately dried without a rise in temperature before packaging.

Spoilage

In 1953 the 8 cars were loaded on 4 different days 2 days to 2 weeks apart, the paired cars being loaded on the same day. Therefore, the fruit is comparable in only the 2 cars in each pair. The data point to differences in the fruit packaged on different days. Although there were temperature differences between the separate berry lots, no consistent corresponding differences in decay were noted. In each pair of cars the higher temperatures were consistently accompanied by higher decay.

The summary of spoilage determined by external examination is found in table 7. Each figure is based on approximately 1,300 uncut berries from 3 bags. Small amounts of decay (1.0 to 1.7 percent) were found in the packaged fruit as it came off the packaging line at Wareham. Decay increased in transit to an average of 1.9 to 4.1 percent per car in the precooled Los Angeles cars and 4.3 to 14.7 percent in the nonprecooled midwestern cars.

Decay also increased during the 7-day period at 70° F. and 80 percent relative humidity, resulting in an average of 4.4 to 8.6 percent for the precooled fruit and 7.5 to 21.7 percent for the nonprecooled fruit. The greater decay in the nonprecooled cars is especially significant, since these cars were in transit 3 to 4 days less than the precooled cars because of the shorter distance to Chicago.

A less consistent relation between transit temperature and decay was found between the top, middle, and bottom positions within each car (table 7). However, as shown in table 8, the lowest percentages of decay generally were associated with the lowest transit temperatures. The least decay was found in the top layers of the precooled cars and the bottom layers of the nonprecooled cars. In evaluating the decay data, one should note that the generally accepted trade practice is to consider 5-percent spoilage the maximum allowable without price discount.

No commercially important physiological breakdown was found in these tests.

Cars 9 to 12 (1954 tests) were loaded on 2 different days, 4 days apart; the paired cars were loaded on the same day. Only the test fruit in each pair of cars is comparable. The results of external examinations are found in table 9, in which each value is based on approximately 1,300 to 1,400 uncut berries in 3 bags.

After prepackaging, the cranberries contained less than 1 percent decay. There was very little increase in decay during the transit period, the Los Angeles test lots averaging about 1 percent on arrival. There was some increase in decay in the Chicago test lots with 4.5 and 7.2 percent in the precooled and nonprecooled lots respectively on arrival. After 7 days at room temperature (70° F.) the decay at Los Angeles averaged 9.5 percent in berries from the precooled car and 12.0 percent in those from the nonprecooled car. At Chicago these percentages were 27.6 and 35.3 respectively. Higher average car temperatures were generally accompanied by a greater amount of decay (table 8).

SUMMARY AND CONCLUSIONS

Eight carloads of consumer-packaged, Massachusetts-grown, Early Black cranberries in master cartons were shipped under standard refrigeration from Wareham, Mass., during September and October 1953, and 4 carloads during October 1954. Fruit temperatures, moisture condensation, and spoilage as affected by (1) precooling, (2) type of load, (3) type of carton, and (4) salting were determined. From a start of 62° to 79° F. 8 hours of precooling with car fans without addition of salt to the bunkers lowered the average load temperature 7.2° while the nonprecooled load dropped only 1.3° during the same period. Precooling 24 hours lowered the load temperature about 17.5° while the nonprecooled loads dropped only 5.1°. Adding salt to the bunkers resulted in faster cooling in the precooled cars and better transit temperatures in both precooled and nonprecooled cars.

Little difference was noted in rate of cooling of fruit in the two load types during the first 8 hours in the 1953 tests. During the remainder of the first 6 days after loading, lower temperatures were found in fruit in the channel loads than in the fruit in the solid loads. Temperatures were only slightly lower in short-flap cartons than in standard cartons; and furthermore, tearing of bags in short-flap cartons makes this container objectionable.

In the initial tests the channel-load pattern held up well to fairly well during transit to Detroit or Chicago. Some shifting was noted in the Los Angeles cars. By spot gluing the strips and having the corrugations run lengthwise of the strips, a more satisfactory performance was obtained.

The fruit held up well in the cars precooled after loading, there being less than 5-percent decay in most positions at arrival. Decay progressed rapidly when the berries were kept at room temperature, suggesting the need for refrigerating the berries at destination. Considerable variation in decay incidence in fruit packed on 6 separate days was noted.

No packages were rejected for moisture condensation on films or cartons or for breakage. However, berries packaged wet after hydrocooling did not keep well and moisture condensed on the bags. Therefore, this method of cooling prior to packaging does not appear desirable.

On the basis of observations made during these tests, the following suggestions seem pertinent for Early Black cranberries:

1. Reduce temperature of fruit as soon after harvest as possible.

2. After fruit is cooled maintain this lower temperature during postharvest period.

3. Reduce temperature of the fruit before packaging if possible to take advantage of the insulating effect of the fiberboard during subsequent handling and loading.

4. Provide some form of ventilation of the master container to facilitate cooling. Provision to prevent tearing of consumer bags through vent openings must be made, however.

5. Provide some form of air channeling between packages to facilitate cooling. The methods described need refinement, and other load patterns should be tried.

6. Ship in fan cars whenever possible and use car fans in transit to cool packaged fruit, especially if it is warm when loaded. If fan cars are not precooled, they should be moved with fans on as soon as possible after loading to speed cooling.

7. When warm berries are shipped in mild weather, use 5-percent salt with initial ice and during precooling and 2 to 3 percent for the first 2 re-icings in transit.

8. Precooling is desirable if the cars remain on track overnight.

9. Store the berries under refrigeration at destination.

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Table 1.--Fruit temperatures in 6 cars of Early Black cranberries from time of packing to time of unloading at market destination, 1953 tests.

Car number	Destination	Description of load	Place temperature was recorded	Temperature at indicated period after packing																		Average temperature	
				Immediately after [1]	1 day[2]	1.5 days	2 days[3]	3 days	4 days	5 days	6 days	7 days	8 days	9 days	10 days	11 days	12 days	13 days	14 days	15 days	16 days	First 7 days[4]	Full trip[4]
				° F.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	° F.
1 ...	Los Angeles	Solid with short-flap carton; Precooled 8 hours	Top carton	68	88	48	50	46	47	42	42	40	42	40	38	37	37	37	36	42	44	49.4	43.9
			Middle carton	67	66	56	58	56	56	50	49	46	48	46	44	41	40	40	41	41	41	55.7	46.5
			Bottom carton	67	68	60	56	54	51	51	48	46	45	47	46	46	44	43	42	42	41	55.4	49.2
			Average	67	68	55	55	53	51	48	46	45	45	44	43	41	40	40	40	42	42	53.5	47.2
			Top air (max.)				61	51	47	41	44	43	45	46	43	39	40	49	51	59	64		
			Top air (min.)				43	41	41	39	38	37	41	36	36	35	35	37	37	48	51		
			Outside air (max.)				75	88	66	69	72	76	--	70	100	-[5]	--	--	--	--	--		
			Outside air (min.)				65	54	42	42	52	51	--	45	46	-[5]	--	--	--	--	--		
2 ...	Chicago	Not precooled	Top carton	88	70	71	69	55	52	44	43	41										54.7	54.7
			Middle carton	67	69	70	70	65	63	57	55	53										62.1	62.1
			Bottom carton	66	68	61	57	57	54	55	53	53										58.0	56.0
			Average	67	69	87	65	59	56	52	50	49										58.2	56.2
			Top air (max.)				64	56	50	46	50	50											
			Top air (min.)				42	40	36	38	38	36											
3 ...	Los Angeles	Solid with standard cartons; Precooled 6 hours	Top carton	74	70	52	52	49	46	46	43	43	45	42	44	43	41	42	41	40	39	51.9	46.3
			Middle carton	77	74	68	65	62	60	58	52	52	50	51	52	50	46	46	44	44	44	61.3	53.8
			Bottom carton	77	71	85	58	57	53	54	53	49	50	46	50	50	51	49	49	48	47	58.1	53.1
			Average	78	72	61	56	56	54	52	49	46	48	47	49	48	47	46	45	44	43	57.1	51.1
			Top air (max.)				52	57	50	45	47	51	49	52	50	47	46	42	40	49	81		
			Top air (min.)				42	37	39	36	36	41	36	46	36	36	37	36	36	37	49		
			Outside (max.)				70	70	70	71	71	73	65	96	76	90	99	73	61	-[5]	--		
			Outside (min.)				42	37	41	60	56	51	65	63	45	71	57	53	-[5]	--	--		
4 ...	Chicago	Not precooled	Top carton	77	72	89	89	61	59	54	52	54	52									61.6	60.4
			Middle carton	79	72	69	69	71	70	71	67	67	66									70.2	69.9
			Bottom carton	78	73	68	62	54	56	53	54	52	50									56.7	57.4
			Average	78	72	69	67	62	82	59	56	58	57									63.6	62.6
			Top air (max.)				62	64	53	47	52	50	50										
			Top air (min.)				55	37	40	37	37	45	40										

See footnotes at end of table.

Table 1.--Fruit temperatures in 8 cars of Early Black cranberries from time of packing to time of unloading at market destination, 1953 tests--Continued

Car number	Destination	Description of load	Place temperature was recorded	Temperature at indicated period after packing																		Average temperature	
				Immediately after [1]	1 day [2]	1.5 days	2 days [3]	3 days	4 days	5 days	6 days	7 days	8 days	9 days	10 days	11 days	12 days	13 days	14 days	15 days	16 days	First 7 days [4]	Full trip [4]
				° F.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	° F.
5 ...	Los Angeles	Channel with short-flap cartons; Precooled 24 hours	Top carton	89	69	44	39	40	38	37	37	38	37	37	37	37	38	39				44.7	41.5
			Middle carton	68	69	57	49	46	42	40	40	39	38	37	36	37	38	38				48.8	43.7
			Bottom carton	69	89	48	51	46	43	41	40	39	38	37	37	37	37	37				49.2	43.3
			Average	89	69	53	46	44	41	39	39	39	38	37	37	37	38	38				47.6	43.0
			Top air (max.)				60	44	42	38	38	38	38	37	35	35	38	42					
			Top air (min.)				36	34	31	31	31	34	31	31	31	31	35	38					
			Outside air (max.)				71	56	57	60	69	70	75	87	72	78	78	79					
			Outside air (min.)				56	55	39	26	38	47	38	41	39	51	53	56					
6 ...	Chicago	Not precooled	Top carton	89	69	68	67	54	42	41	39	41	43	43	45	45	45	46	48	46	46	52.7	48.5
			Middle carton	69	69	71	67	58	49	45	42	41	41	40	40	40	40	41	41	42	42	55.1	47.5
			Bottom carton	69	70	63	56	50	48	45	42	41	41	40	39	39	39	39	39	39	39	52.5	45.4
			Average	69	89	67	63	54	46	44	41	41	42	41	41	41	41	42	42	42	42	53.6	47.1
			Top air (max.)				67	59	50	44	48	50	50	48	49	50	50	50	52	52	52		
			Top air (min.)				59	35	34	34	34	44	46	46	44	44	47	45	44	47	48		
7 ...	Los Angeles	Channel with standard cartons; Precooled 24 hours	Top carton	67	85	50	44	43	42	39	38	38	38	38	37	38	36	37	38			48.3	41.8
			Middle carton	67	65	57	51	49	46	43	41	40	39	39	38	37	37	37	37			50.0	44.0
			Bottom carton	87	66	60	53	46	44	42	41	40	40	40	40	39	39	39	39			49.5	44.6
			Average	67	65	56	49	48	44	41	40	39	39	39	48	37	37	38	38			48.6	43.5
			Top air (max.)				56	43	45	39	39	39	40	39	38	35	37	38	41				
			Top air (min.)				38	37	35	34	34	33	33	33	32	32	33	32	38				
			Outside air (max.)				58	58	70	74	74	81	71	79	90	64	69	89	79				
			Outside air (min.)				48	41	37	35	46	54	50	47	50	40	42	45	58				
8 ...	Detroit	Not precooled	Top carton	67	62	62	61	68	47	44	40	38	44	57	[6]64)							52.3	52.4
			Middle carton	67	63	63	61	56	51	47	44	40	42	53	82)							53.9	53.1
			Bottom carton	67	64	57	51	45	42	40	39	38	37	52	61)							48.0	48.2
			Average	67	63	81	58	53	47	44	41	39	41	54	62)							51.4	51.3
			Top air (max.)				58	56	52	44	40	42	--	--	--								
			Top air (min.)				56	52	36	36	45	35	--	--	--								

[1] Immediately after packaging fruit (1 day prior to loading).
[2] Loading completed and precooling started.
[3] Left Wareham.
[4] Weighted average.
[5] Ryan not inking.
[6] Packages en route from Detroit to Chicago in unrefrigerated carrier during period covered by last 3 readings.

Table 2.--Temperatures in cars of cranberries during precooling period: Effect of refrigeration method, container type and load pattern on temperature reduction, 1953 tests

Car number	Destination	Description of load	Time or item	Air temperature			Fruit temperature [1]												
				Out-side	Inside car		Bunker			Quarterlength			Doorway			Average			
					Top	Bottom	Top	Middle	Bottom	Top	Middle	Bottom	Top	Middle	Bottom	Top	Middle	Bottom	Car
				° F.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	° F.
1 ...	Los Angeles	Solid with short-flap cartons:																	
		Precooled 6 hours	Start	75	65.5	33.5	66.0	66.0	65.0	66.0	68.0	65.0	64.0	65.0	66.5	65.3	67.5	65.5	66.1
			After 6 hours	66	40.5	52.0	55.5	66.0	57.5	54.0	56.5	59.0	55.5	56.5	62.5	55.0	61.0	59.7	56.6
			Reduction in 6 hours				10.5	2.0	7.5	12.0	9.5	6.0	6.5	6.5	4.0	10.3	6.5	5.6	7.5
			After 24 hours	64	50.5	33.0	54.0	64.0	54.0	51.0	58.0	54.4	52.5	59.0	56.5	52.5	60.3	55.7	56.2
			Reduction in 24 hours				12.0	4.0	11.0	15.0	10.0	10.5	11.5	6.0	6.0	12.6	7.2	9.6	9.9
2 ...	Chicago	Not precooled	Start	76	65.0	34.5	66.0	65.5	67.0	67.0	66.0	65.5	67.5	65.5	66.5	66.6	65.7	66.3	66.2
			After 6 hours	66	62.5	34.0	67.0	66.5	64.0	66.0	67.0	56.5	66.0	66.5	63.5	67.7	66.7	62.0	65.5
			Reduction in 6 hours				[2] +1.0	+1.0	3.0	+1.0	+1.0	7.0	+0.5	+1.0	3.0	+0.9	+1.0	4.3	.7
			After 24 hours	64	6.15	34.0	66.5	66.5	56.5	67.0	66.5	52.5	67.0	66.5	59.0	66.6	66.5	56.7	63.3
			Reduction in 24 hours				+0.5	+1.0	6.5	0	+0.5	13.0	.5	+1.0	7.5	0	+0.6	9.6	2.9
3 ...	Los Angeles	Solid with standard cartons:																	
		Precooled 6 hours	Start	56	56.0	34.0	75.5	75.0	65.5	72.0	71.0	69.0	69.5	70.5	71.0	72.3	72.5	66.5	71.1
			After 6 hours	52	52.0	51.5	64.5	72.5	61.0	61.0	65.0	63.0	57.0	62.0	61.0	60.8	66.5	61.7	63.0
			Reduction in 6 hours				11.0	2.5	4.5	11.0	6.0	6.0	12.5	6.5	10.0	11.5	6.0	6.6	6.1
			After 24 hours	53	52.0	33.5	60.5	70.5	54.5	56.5	64.5	59.0	56.5	60.5	57.0	57.3	65.2	56.6	59.6
			Reduction in 24 hours				15.0	4.5	11.0	15.5	6.5	10.0	13.0	10.0	14.0	15.0	6.3	11.7	11.3
4 ...	Chicago	Not precooled	Start	60	56.5	33.0	69.0	66.5	70.5	69.5	70.5	69.0	73.0	75.0	67.0	70.5	71.3	66.6	70.2
			After 6 hours	52	60.5	33.5	66.0	66.0	62.0	69.0	70.0	64.5	71.0	75.0	63.0	69.3	70.3	63.2	67.6
			Reduction in 6 hours				1.0	2.5	6.5	.5	.5	4.5	2.0	0	4.0	1.2	1.0	5.6	2.6
			After 24 hours	53	57.5	33.0	66.0	64.0	54.5	66.0	70.0	57.5	70.0	75.0	57.0	66.0	69.7	56.3	64.7
			Reduction in 24 hours				3.0	4.5	16.0	1.5	.5	11.5	3.0	0	10.0	2.5	1.6	12.5	5.5

See footnotes at end of table.

Table 2.--Temperatures in cars of cranberries during precooling period: Effect of refrigeration method, container type and load pattern on temperature reduction, 1953 tests -- Continued

Car number	Destination	Description of load	Time or item	Air temperature			Fruit temperature 1/												
				Out-side	Inside car		Bunker			Quarterlength			Doorway			Average			
					Top	Bottom	Top	Middle	Bottom	Top	Middle	Bottom	Top	Middle	Bottom	Top	Middle	Bottom	Car
				° F.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	° F.
5 ...	Los Angeles	Channel with short-flap cartons:																	
		Precooled 24 hours	Start	72	70.0	38.5	67.5	66.5	67.0	69.5	70.0	68.0	67.5	65.5	65.0	68.2	87.3	66.7	67.4
			After 8 hours	64	36.5	44.0	58.0	62.5	59.0	58.0	65.0	62.0	61.0	60.0	59.5	58.3	62.5	60.2	60.3
			Reduction in 8 hours				9.5	4.0	8.0	13.5	5.0	6.0	6.5	5.5	5.5	9.9	4.8	6.5	7.1
			After 24 hours	59	37.0	41.0	44.5	52.0	49.0	42.0	53.0	51.0	53.0	51.0	49.5	46.5	52.0	49.8	49.4
			Reduction in 24 hours				23.0	14.5	18.0	27.5	17.0	17.0	14.5	14.5	15.5	21.7	15.3	16.9	18.0
6 ...	Chicago	Not precooled	Start	72	69.0	40.0	69.0	70.5	64.5	70.0	70.5	75.0	72.5	71.0	68.5	70.5	70.7	69.3	70.2
			After 8 hours	64	62.5	35.5	69.5	71.0	62.5	71.0	72.5	68.0	71.5	72.0	67.0	70.7	71.8	85.8	69.4
			Reduction in 8 hours				+0.5	+0.5	2.0	+1.0	+2.0	7.0	1.0	+1.0	1.5	+0.2	+1.1	3.5	0.8
			After 24 hours	56	59.5	34.5	67.0	67.0	54.5	68.5	69.0	57.5	66.5	69.0	58.5	67.3	68.3	56.8	64.1
			Reduction in 24 hours				2.0	3.5	10.0	1.5	1.5	17.5	6.0	2.0	10.0	3.2	2.4	12.5	6.1
7 ...	Los Angeles	Channel with standard cartons:																	
		Precooled 24 hours	Start	55	57.0	36.0	68.0	65.5	66.5	86.0	66.0	70.5	68.5	67.5	65.5	67.5	66.3	67.5	67.1
			After 8 hours	52	37.0	44.0	58.5	60.5	61.0	57.0	60.5	63.5	63.0	61.0	63.0	59.5	60.7	62.5	60.9
			Reduction in 8 hours				9.5	5.0	5.5	9.0	5.5	7.0	5.5	6.5	2.5	8.0	5.6	5.0	6.2
			After 24 hours	49	37.0	42.0	46.5	51.0	51.0	44.5	50.0	52.5	50.0	52.0	54.5	47.0	51.0	52.7	50.2
			Reduction in 24 hours				21.5	14.5	15.5	11.5	16.0	18.0	18.5	16.5	11.0	20.5	15.3	14.8	16.9
8 ...	Detroit	Not precooled	Start	56	57.5	35.5	68.5	70.0	69.0	67.0	67.0	67.0	66.5	66.0	66.0	67.3	67.7	67.3	67.4
			After 8 hours	52	59.0	36.5	67.0	70.0	64.5	67.5	67.5	64.0	66.5	67.0	63.5	67.0	68.2	64.0	66.4
			Reduction in 8 hours				1.5	0	4.5	+0.5	+0.5	3.0	0	+1.0	2.5	.3	+0.5	3.3	1.0
			After 24 hours	50	56.5	36.0	63.5	66.0	55.5	64.0	64.5	56.0	64.0	64.5	56.0	63.8	65.0	55.8	61.5
			Reduction in 24 hours				5.0	4.0	13.5	3.0	2.5	11.0	2.5	1.5	10.0	3.5	2.7	11.5	5.9

1/ All temperatures taken in center line of car.

2/ + indicates rise in temperature

Table 3.--Temperatures in 4 cars of Early Black cranberries during precooling period: Effect of refrigeration method on temperature reduction, 1954 tests.

Car number	Destination	Description of load	Time or item	Air temperature			Fruit temperature[1]												
				Outside	Inside car		Bunker			Quarterlength			Doorway			Average			
					Top	Bottom	Top	Middle	Bottom	Top	Middle	Bottom	Top	Middle	Bottom	Top	Middle	Bottom	Car
				° F.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	° F.
9 ...	Los Angeles	Channel with standard cartons:																	
		Precooled 19 hours	Start (after loading)	74	69	31.5	74.5	66	66	72.5	69.5	63.5	75.0	75.0	74.0	74.0	70.2	67.8	70.6
			After 7 hours	75	44.0	47.0	60.0	52.0	58.5	55.5	54.5	52.5	55.5	68.5	63.0	57.0	58.3	58.0	57.6
			Reduction in 7 hours				14.5	14.0	7.5	17.0	15.0	11.0	19.5	6.5	11.0	17.0	11.9	9.8	13.0
			After 19 hours	67	41.0	44.0	49.0	46.5	50.5	47.0	49.5	45.5	45.5	56.5	53.0	47.2	50.8	49.7	49.3
			Reduction in 19 hours				25.5	19.5	15.5	25.5	20.0	18.0	29.5	18.5	21.0	26.8	19.4	18.1	21.3
10 ...	Los Angeles	Not precooled	Start (after loading)	78	70.5	35.5	75.5	76.0	60.5	73.0	66.0	73.0	76.0	75.5	75.5	74.8	72.5	69.7	72.2
			After 7.3 hours	70	67.0	35.0	70.5	70.5	52.0	74.0	61.5	65.5	71.0	71.0	73.0	71.8	67.7	63.5	67.7
			Reduction in 7.3 hours				5.0	5.5	8.5	[2]+1.0	4.5	7.5	5.0	4.5	2.5	3.0	4.8	6.2	4.5
			After 15.3 hours	67	65.0	29.0	68.0	65.5	43.5	72.0	58.0	59.0	68.0	66.5	66.5	69.3	63.3	56.3	63.0
			Reduction in 15.3 hours				7.5	9.5	17.0	1.0	8.0	14.0	8.0	9.0	9.0	5.5	9.2	13.4	9.2
11 ...	Chicago	Precooled 18.5 hours	Start (after loading)	64	62.0	28.5	65.0	67.5	56.0	64.5	65.5	62.5	70.0	70.0	66.0	66.5	67.7	61.5	65.2
			After 7.5 hours	61	39.0	43.5	50.5	59.0	49.0	51.0	56.0	51.0	51.0	53.5	51.0	50.8	56.2	50.3	52.6
			Reduction in 7.5 hours				14.5	8.5	7.0	13.5	9.5	11.5	19.0	16.5	15.0	15.7	11.5	11.2	12.6
			After 18.5 hours	56	38.5	40.5	43.0	51.5	43.5	43.5	48.5	44.0	43.5	48.5	43.5	43.3	49.5	43.7	45.4
			Reduction in 18.5 hours				22.0	16.0	12.5	21.0	17.0	18.5	26.5	21.5	22.5	23.2	18.2	17.8	19.8
12 ...	Chicago	Not precooled	Start (after loading)	64	60.5	28.0	61.0	63.5	46.0	61.5	58.5	62.0	66.5	66.5	65.5	63.0	62.8	57.8	61.2
			After 7 hours	61	59.0	33.0	60.5	56.0	40.5	61.5	58.5	55.5	65.5	63.5	57.0	62.5	59.3	51.0	57.6
			Reduction in 7 hours				0.5	7.5	5.5	0.0	0.0	6.5	1.0	3.0	8.5	0.5	3.5	6.8	3.6
			After 16 hours	56	57.0	27.5	57.5	51.0	33.5	60.5	55.5	49.0	64.0	59.5	51.0	60.7	55.3	44.5	53.5
			Reduction in 16 hours				3.5	12.5	12.5	1.0	3.0	13.0	2.5	7.0	14.5	2.3	7.5	13.3	7.7

[1] All temperatures taken in center line of car.
[2] + indicates rise in temperature.

Table 4.--Fruit temperatures in 4 cars of Early Black cranberries from time of packing to time of arrival at market destination, 1954 tests.

Car number	Destination	Description of load	Place temperature was recorded	Immediately after	Temperature at indicated period after packing															
					1 day	1.5 days	2 days	3 days	4 days	5 days	6 days	7 days	8 days	9 days	10 days	11 days	12 days	13 days	First 5 days	Full trip
				° F.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	° F.
9 ...	Los Angeles	Channel with standard cartons: Precooled 19 hours	Top carton	76	72	58	55	49	44	43	39	34	33	32	32	33	35	38	56.7	44.9
			Middle carton	76	75	69	62	54	49	45	42	38	36	35	34	34	34	34	61.4	47.8
			Bottom carton	76	62	54	48	42	39	38	35	33	33	33	33	34	35	35	51.3	42.0
			Bottom carton(at bunker)	76	63	54	48	41	39	35	35	32	32	32	32	32	32	32	50.8	41.0
			Average 1/	76	70	60	53	48	44	42	39	35	34	33	33	34	35	36	56.4	44
			Top air (max.)				51	46	46	46	41	41	39	38	44	43	45	48		
			Top air (min.)				56	34	34	34	31	30	32	31	33	36	41	44		
10 ..	Los Angeles	Not precooled	Top carton	76	73	73	69	52	46	43	38	34	33	33	32	34	37	39	61.7	47.5
			Middle carton	77	75	74	69	59	52	48	44	40	38	37	36	35	35	35	58.0	50.3
			Bottom carton	76	71	59	52	47	42	41	36	35	35	35	34	35	35	35	55.4	44.5
			Bottom carton(at bunker)	77	73	59	48	40	36	35	33	30	30	31	31	31	32	32	52.6	41.2
			Average 1/	76	73	69	63	53	47	44	39	36	35	35	34	35	36	36	60.7	47.4
			Top air (max.)				61	50	49	43	44	38	37	47	44	47	52	-		
			Top air (min.)				35	34	35	28	29	29	31	29	31	33	40	-		
			Outside air (max.)				86	81	76	59	62	73	86	-	-	-	-	-		
			Outside air (min.)				64	68	47	48	46	56	58	-	-	-	-	-		
11 ..	Chicago	Precooled 18.5 hours	Top carton	70	65	57	51	42	37	35									51.0	51.0
			Middle carton	71	68	61	55	46	40	37									54.0	54.0
			Bottom carton	72	60	50	44	37	35	35									47.6	47.6
			Bottom carton(at bunker)	71	56	47	36	33	33	33									44.1	44.1
			Average 1/	71	64	56	50	42	37	36									50.7	50.7
12 ..	Chicago	Not precooled	Top carton	72	69	67	64	51	43	39									57.9	57.9
			Middle carton	70	62	64	62	52	44	39									56.1	56.1
			Bottom carton	70	65	53	48	42	36	35									49.9	49.9
			Bottom carton(at bunker)	72	62	53	46	40	38	35									49.4	49.4
			Average 1/	71	65	61	58	48	41	38									54.0	54.0
			Outside air (max.)					46	60	77										
			Outside air (min.)					34	34	58										

1/ Average--bottom carton (at bunker) not included.

Table 5. Icing record for cars of cranberries: Ice supplied and melted, Boston to Chicago, 1953 tests.

Car number and identification	Date leaving Wareham	Destination	Description of load	Ice placed in bunkers at -						Approximate total ice meltage
				Boston before loading	Wareham		Maybrook	East Buffalo	Chicago	
					1st icing	2nd icing				
				Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds
1 - WFE 69234 ...	September 21	Los Angeles	Solid with short-flap cartons: Precooled 8 hours	10,000	4,200	-	6,000	3,000	2,800	16,000
2 - FGE 59913 ...	September 21	Chicago	Not precooled	10,000	3,000	-	4,800	3,000	2,400	13,200
3 - WFE 68517 ...	September 23	Los Angeles	Solid with standard cartons: Precooled 8 hours	9,600	2,400	3,600	4,200	4,000	2,400	16,600
4 - BRE 76687 ...	September 23	Chicago	Not precooled	10,000	2,700	-	3,000	4,000	3,200	12,900
5 - PFE 200483...	October 5	Los Angeles	Channel with short-flap cartons: Precooled 24 hours	12,400	2,400	3,900	4,000	3,000	2,000	15,300
6 - FGE 59778 ...	October 5	Chicago	Not precooled	10,000	3,000	-	4,500	2,000	2,400	12,900
7 - PFE 200329...	October 7	Los Angeles	Channel with standard cartons: Precooled 24 hours	12,400	2,100	3,000	4,800	2,000	1,800	13,700
8 - PFE 3030 ...	October 8	Detroit	Not precooled	11,300	2,100	1,200	4,400	1,800	-	9,500

Table 6.--Icing record for cars of cranberries: Ice and salt supplied and ice melted, Boston to Chicago and Los Angeles, 1954 tests.

Car number and identification	Date leaving Plymouth	Destination	Description of load	Initial icing and salting before loading Boston	Ice and salt placed in bunkers at - Plymouth	May-brook	East Buffalo	Detroit	Dalhart	El Paso	Yuma	Approximate total ice meltage
				Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds
9 - WFE 69286	October 2	Los Angeles[1]	Channel with standard cartons: Precooled 19 hours	Ice 10,000 Salt 500	5200 [2] 350	1800 54	2500 75	3200 96	1200 0	3000 90	2400 0	27,050 ---
10 - WFE 69436 ...	October 2	Los Angeles	Not precooled	Ice 10,000 Salt 500	6900 500	4000 120	4000 120	3200 96	1200 0	2700 81	2700 0	28,450 ---
11 - WFE 68601 ...	October 6	Chicago	Precooled 18 hours	Ice 9,600 Salt 480	7600 448	2200 66	2000 60	1600 48	--- ---	--- ---	--- ---	14,360 ---
12 - WFE 69349 ...	October 6	Chicago	Not precooled	Ice 10,000 Salt 500	5700 371	2400 72	2000 60	1600 48	--- ---	--- ---	--- ---	12,700 ---

[1] Test packages and part of load unloaded at Los Angeles; rest of load diverted to San Diego.
[2] Not iced to capacity at Plymouth because of shortage of ice; 4000 pounds of ice and 120 pounds of salt were added in Boston.

Table 7. Decay in packaged cranberries: Effect of shipping conditions on progressive increase from time of packing to end of holding period after transit, 1953 tests.

Car number	Destination	Description of load	Place temperature was recorded	Average temperature to end of transit period ° F.	Percentage of berries decayed				
					When packed	At end of transit period	Held at 70° F 80 percent humidity		Average
							3 days	7 days	
					Pct.	Pct.	Pct.	Pct.	Pct.
1 ...	Los Angeles	Solid with short-	Top carton	43.9	1.7	2.6	4.6	6.5	4.6
		flap cartons	Middle carton	48.5		4.3	5.3	8.4	6.0
		Precooled 8 hours	Bottom carton	49.2		5.4	6.2	8.6	6.7
			Average	47.2		4.1	5.4	7.8	
2 ...	Chicago	Not precooled	Top carton	54.7	1.7	4.3	2.8	10.2	5.8
			Middle carton	62.1		3.8	8.8	10.9	7.8
			Bottom carton	58.0		4.7	9.4	12.6	8.9
			Average	58.2		4.3	7.0	11.2	
3 ...	Los Angeles	Solid with standard	Top carton	46.3	1.1	2.1	1.5	4.0	2.5
		cartons	Middle carton	53.8		4.3	2.8	3.9	3.7
		Precooled 8 hours	Bottom carton	53.1		2.4	2.2	5.4	3.3
			Average	51.1		2.9	2.2	4.4	
4 ...	Chicago	Not precooled	Top carton	60.4	1.1	4.0	7.4	7.2	6.2
			Middle carton	69.9		5.8	8.9	7.8	7.5
			Bottom carton	57.4		3.0	5.3	7.4	5.2
			Average	62.6		4.3	7.2	7.5	
5 ...	Los Angeles	Channel with short-	Top carton	41.5	1.0	1.3	5.2	7.0	4.5
		flap cartons	Middle carton	43.7		2.5	2.2	4.1	2.9
		Precooled 24 hours	Bottom carton	43.8		1.9	2.3	5.3	3.2
			Average	43.0		1.9	3.2	5.5	
6 ...	Chicago	Not precooled	Top carton	48.5	1.0	19.0	19.8	27.2	22.0
			Middle carton	47.5		18.3	21.7	27.6	22.5
			Bottom carton	45.4		6.9	10.0	10.2	9.0
			Average	47.1		14.7	17.2	21.7	
7 ...	Los Angeles	Channel with	Top carton	41.8	1.6	1.6	3.9	5.8	3.8
		standard cartons	Middle carton	44.0		1.8	3.7	10.0	5.2
		Precooled 24 hours	Bottom carton	44.6		2.4	4.5	10.0	5.6
			Average	43.5		1.9	4.0	8.6	
8 ...	Detroit	Not precooled	Top carton	52.4	1.6	6.1	13.3	17.0	12.1
			Middle carton	53.1		5.3	11.6	11.7	9.5
			Bottom carton	48.2		5.6	11.2	21.4	12.7
			Average	51.3		5.7	12.0	16.7	

Table 8.--Decay in packaged cranberries: Relation to average temperature in transit, 1953 and 1954 tests.

Treatment and carton position	1953 tests		1954 tests	
	Average temperature	Average decay	Average temperature	Average decay
	° F.	Percent	° F.	Percent
Precooled:				
Top carton (Quarterlength)	43.1	3.8	48.0	11.6
Middle carton (Quarterlength)...	47.5	4.4	50.9	10.5
Bottom carton (Quarterlength)...			44.8	9.2
Bottom carton (Bunker)			42.6	10.6
Bottom carton (Doorway)	47.7	4.7		
Non-precooled:				
Top carton (Quarterlength)	54.0	11.5	52.7	15.0
Middle carton (Quarterlength)...	58.2	11.8	53.2	13.8
Bottom carton (Quarterlength)...			47.2	10.4
Bottom carton (Bunker)			45.3	9.4
Bottom carton (Doorway)	52.2	8.9		

Table 9.--Decay in packaged cranberries: Effect of shipping conditions on progressive increase from time of packing to end of holding period after transit, 1954 tests

Car number	Destination	Description of load	Place temperature was recorded	Average temperature to end of transit period	Percentage of berries decayed				
					When packed	At end of transit period	Held at 70° F. 80 percent humidity		Average
							3 days	7 days	
				° F.	Pct.	Pct.	Pct.	Pct.	Pct.
9 ...	Los Angeles	Channel with standard cartons Precooled 19 hours	Top carton	44.9	0.1	0.8	3.6	10.7	5.3
			Middle carton	47.8		0.7	3.8	10.1	4.9
			Bottom carton	42.0		0.9	3.5	7.6	4.0
			Bottom bunker carton	41.0		0.7	3.3	8.7	4.2
			Average 1/	44.9		0.8	3.6	9.5	
10 ...	Los Angeles	Not precooled	Top carton	47.5	0.8	1.3	6.8	14.8	7.6
			Middle carton	50.3		1.3	6.0	11.5	6.3
			Bottom carton	44.5		0.7	2.9	9.8	4.5
			Bottom bunker carton	41.2		1.2	3.3	7.1	3.9
			Average 1/	47.4		1.1	5.2	12.0	
11 ...	Chicago	Precooled 18.5 hours	Top carton	51.0	0.8	4.5	17.5	31.8	18.0
			Middle carton	54.0		3.5	19.1	25.8	16.1
			Bottom carton	47.6		5.5	12.7	25.1	14.4
			Bottom bunker carton	44.1		4.7	13.8	32.5	17.0
			Average 1/	50.9		4.5	16.4	27.6	
12 ...	Chicago	Not precooled	Top carton	57.9	0.6	10.1	18.5	38.7	22.4
			Middle carton	56.1		5.7	20.3	38.2	21.4
			Bottom carton	49.9		5.9	13.6	29.0	16.2
			Bottom bunker carton	49.4		7.2	9.0	28.7	15.0
			Average 1/	54.6		7.2	17.5	35.3	

1/ Average -- Bottom carton (at bunker) not included.

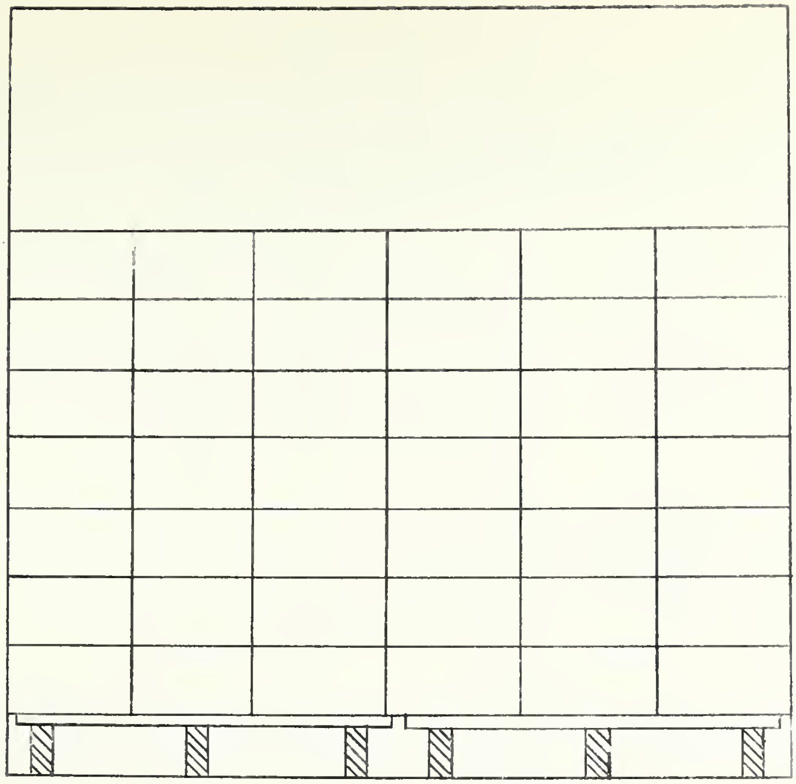

Figure 1 - Solid Load

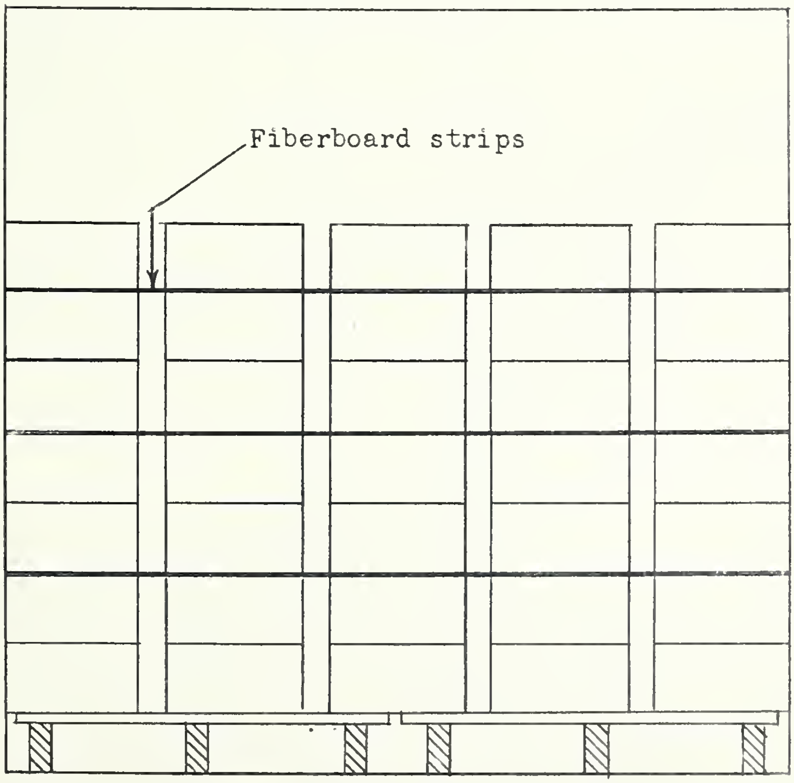

Figure 2 - Channel Load

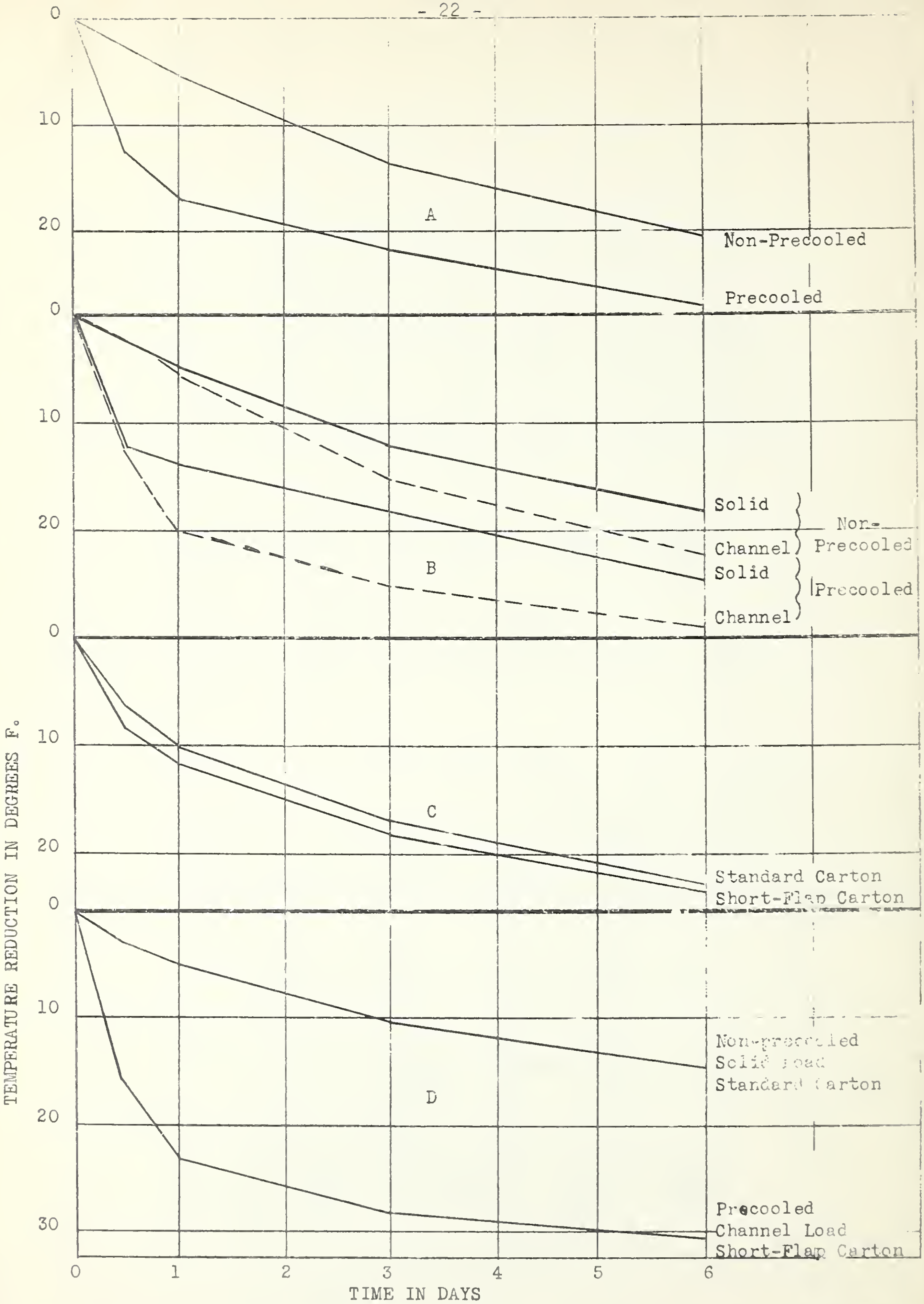

FIGURE 3. AVERAGE REDUCTION IN TEMPERATURES OF EARLY BLACK CRANBERRIES PACKAGED AND LOADED IN DIFFERENT WAYS IN PRECOOLED AND NON-PRECOOLED LOADS DURING 6 DAYS AFTER LOADING. 1953 TESTS.

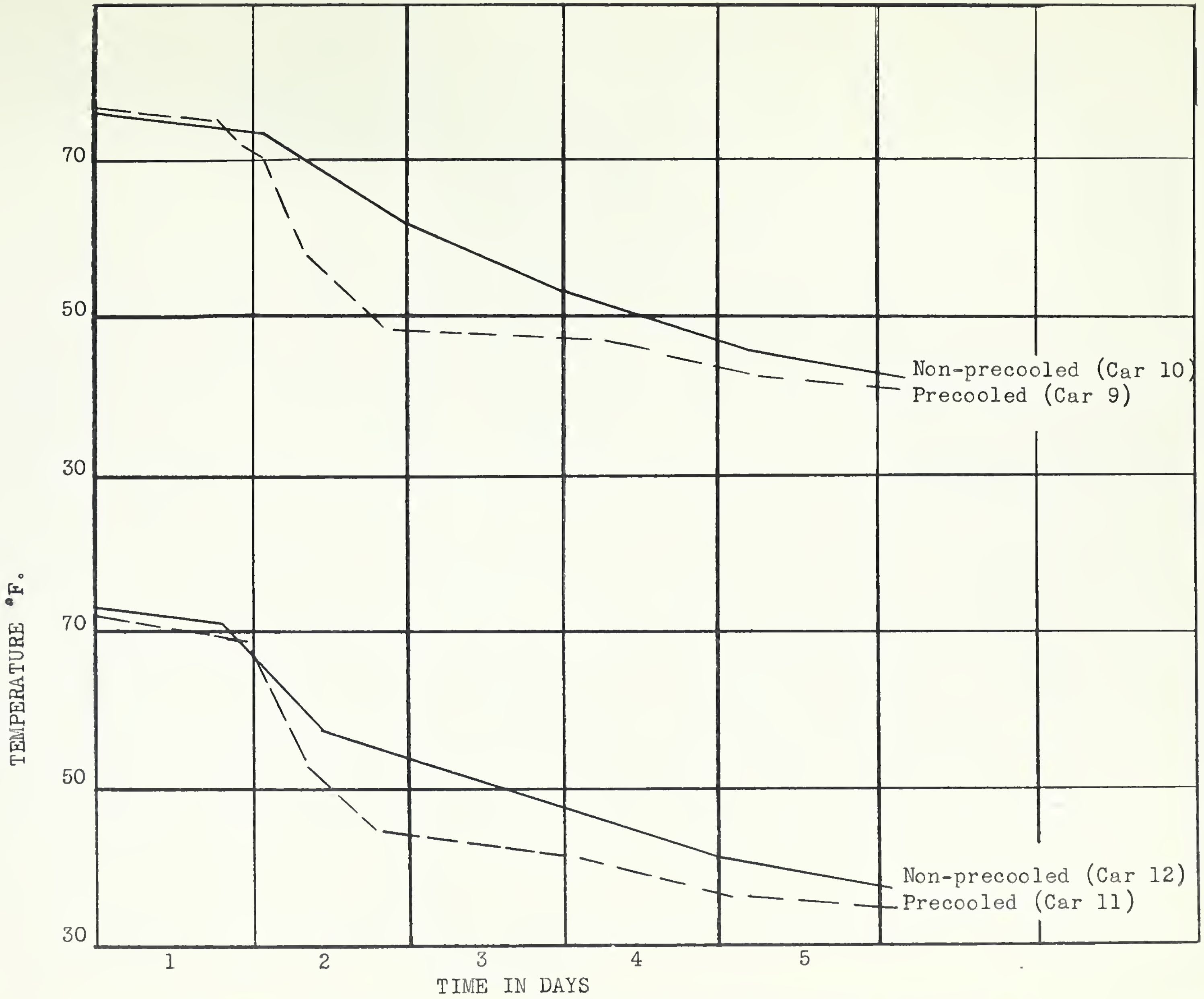

FIGURE 4. AVERAGE TEMPERATURES OF EARLY BLACK CRANBERRIES IN PRECOOLED AND NON-PRECOOLED LOADS DURING 5 DAYS AFTER PACKAGING. 1954 TESTS.